# SCIENCE AND TECHNOLOGY BENEFIT ANALYSIS

Idaho Operations Office – Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho LLC

## Remote Semi-Automatic Welding System

The Spent Nuclear Fuel (SNF) program utilized a remotely operated, semi-automatic welding system manufactured by Welding Services Inc. (WSI) to weld radiological shield plugs into the dry shielded canisters (DSC) used in the Three Mile Island Unit 2 project. The welding system is a gas tungsten arc welding (GTAW) process that is capable of being operated in either a manual or semi-automatic mode after completion of a manual set-up process. The welding system has the unique capability of having two independently operated weld heads which when operating simultaneously essentially doubles the welding rate.

Benefit: Schedule improvement that led to completion of project in time to meet the state settlement agreement. Use of the welding system provided an estimated net cost savings of $2,000 K. (See attached worksheet for details)

| Qualitative Benefit Analysis | | |
|---|---|---|
| Programmatic Risk | ● | Assurance of meeting project milestones with an increase in safety and a decrease in radiological exposure was greatly improved by utilizing the remote semi-automatic welding system. |
| Technical Adequacy | ● | The new technology/method provided a faster weld deposition rate that was achieved with minimal to no rework required. |
| Safety | ● | The automated welding system reduced weld inspection time which resulted in reduced radiological exposures. Radiation exposure avoidance of $7.6K was realized and complied with as low as reasonably achievable (ALARA) levels. |
| Schedule Impact | ● | The deployment of the remote semi-automatic welding system was an integral part in helping to achieve the milestone of completing the transfer of the Three Mile Island Fuel from TAN to the INTEC dry storage facility before June 1, 2001. This milestone is defined in the 1995 Settlement Agreement between the Department of Energy and the State of Idaho. |

● Major improvement ◒ Some improvement ○ No change ◓ Somewhat worse ◉ Major Decline

| Quantitative Benefit Analysis | |
|---|---|
| Cost Impact Analysis | By completing this significant action in a timely fashion, the INEEL and the Department of Energy avoided potential closure of the state of Idaho borders to future spent nuclear fuel shipments to the INEEL. Additional associated costs and negative publicity were also avoided.<br><br>By meeting the Settlement Agreement date, a benefit was achieved for the INEEL and the Department of Energy. On both a local and a national level, public confidence and trust in the Department of Energy and the INEEL were validated and enhanced. |

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# Addendum to Remote Semi-Automatic Welding System

This technology deployment partially addresses an identified STCG need 1.1.22: Intelligent Welding and Real Time NDE Technology for Quality Verification of SNF Canister Closure Seal Welds

ESTIMATE BASIS FOR: Automatic Welding System

**Worksheet 1: Operating & Maintenance Annual Recurring Costs**

| Expense Cost Items * | Before (B) Annual Costs | After (A) Annual Costs |
|---|---|---|
| 1. Equipment | $ - | $ - |
| 2. Purchased Raw Materials and Supplies | $ - | $ - |
| 3. Process Operation Costs: | | |
| Utility Costs | $ - | $ - |
| Labor Costs | $ 1,663,875 | $ 623,565 |
| Routine Maintenance Costs for Processes | $ - | $ 2,025,000 |
| Subtotal | $ 1,663,875 | $ 2,648,565 |
| 4. PPE and Related Health/Safety/Supply Costs | $ - | $ - |
| 5. Waste Management Costs: | | |
| Waste Container Costs | $ - | $ - |
| Treatment/Storage/Disposal Costs | $ - | $ - |
| Inspection/Compliance Costs | $ - | $ - |
| Subtotal | $ - | $ - |
| 6. Recycling Costs | | |
| Material Collection/Separation/Preparation Costs: | | |
| a) Material and Supply Costs | $ - | $ - |
| b) Operations and Maintenance Labor Costs | $ - | $ - |
| Vendor Costs for Recycling | $ - | $ - |
| Subtotal | $ - | $ - |
| 7. Administrative/other Costs | $ 3,000,000 | $ - |
| Total Annual Cost: | $ 4,663,875 | $ 2,648,565 |

* See attached Supporting Data and Calculations.

# ESTIMATE BASIS FOR: Automatic Welding System

**Worksheet 2: Itemized Project Funding Requirements***
**(i.e., One Time Implementation Costs)**

| Category | Cost $ |
|---|---|
| **INITIAL CAPITAL INVESTMENT** | |
| 1. Design | $ - |
| 2. Purchase | $ - |
| 3. Installation | $ - |
| 4. Other Capital Investment (explain) | $ 675,000 |
| **Subtotal: Capital Investment= (C)** | |
| **INSTALLATION OPERATING EXPENSES** | |
| 1. Planning/Procedure Development | $ - |
| 2. Training | $ - |
| 3. Miscellaneous Supplies | $ - |
| 4. Startup/testing | $ - |
| 5. Readiness Reviews/Management Assessment/Administrative Costs | $ - |
| 6. Other Installation Operating Expenses (explain) | $ 1,350,000 |
| **Subtotal: Installation Operating Expense = (E)** | $ 1,350,000 |
| 7. All company adders (G & A/PHMC Fee, MPR, GFS, Overhead, taxes, etc.)(if not contained in above items) | $ - |
| **Total Project Funding Requirements=(C + E)** | $ 2,025,000 |
| Useful Project Life = (L) 1 Years Time to Implem 6 Months | |
| **Estimated Project Termination/Disassembly Cost (if applicable) = (D)** (Only for Projects where L<5 years; D=0 if L>5 years) | $ - |

**TOTAL LIFE-CYCLE COST SAVINGS CALCULATION FOR IPABS-IS**

*(Before - After) x (Useful Life) - (Total Project Funding Requirements + Termination)*

Total Life Cycle Cost Savings Estimate = (B - A) x L - (C+E+D)

**RETURN ON INVESTMENT CALCULATION**

Return on Investment (ROI) % =

$$\frac{\textit{(Before - After) - [(Total Project Funding Requirements + Termination)/Useful Life]}}{\textit{[Total Project Funding Requirements + Project Termination]}} \times 100$$

$$ROI = \frac{(B-A)-[(C+E+D)/L}{(C+E+D)} \times 100 \; -100 \; \%$$

| O&M Annual Recurring Costs: | | | Project Funding Requirements: | | | |
|---|---|---|---|---|---|---|
| Annual Costs, Before= | $ 4,663,875 | (B) | Capital Investment= | $ 675,000 | (C) | |
| Annual Costs, After= | $ 2,648,565 | (A) | Installation Op. Exp= | $ 1,350,000 | (E) | |
| Net Annual Savings= | $ 2,015,310 | (B-A) | Total Project Funds= | $ 2,025,000 | (C+E) | |

Note: Before (B) and After (A) are Operating & Maintenance Annual Recurring Costs from Worksheet 1.

* See attached Supporting Data and Calculations.

# ESTIMATE BASIS FOR: Automatic Welding System

**Weld time savings:**

| No. | Weld | Weld time (hours) | Prep and Repair Time (hours) | Inspection time (hours) | Process | Time saving (hours) | Notes |
|---|---|---|---|---|---|---|---|
| 1 | DSC weld 1 | 12 | 8 | 7 | Manual | Baseline | Two welders and two inspectors. |
| 2 | DSC weld 15 | 5.5 | 0 | 3.5 | Remote Semi-Auto | 18 | Three welders and one inspector. |
| | | | | | | | 27 DSC's X 18 hours = 20.25 days savings |
| **Labor and Operation Savings:** Example: 2.42 (Composite multiplier) X ~$25.00 (Wage) + 8.55 (facility) = $69.10 billing rate. Using this method for all employees you arrive at a billing rate of approximately $2,125 hr/day. | | | | | | | $2,125 hr/day X 24 X 20.25 days = $1,032,750 |
| **Milestone:** Although not reportable the positive exposure and ramifications from completing a milestone ahead of schedule would result in a savings. | | | | | | | ~$750,000 (estimated - hidden cost savings) |
| | | | | | | **Total:** | $1,032,750 |

**Radiological Exposure:**

| No. | Weld | Welder Exposure | InspectorExposure | Total Exposure | Exposure Savings | Notes |
|---|---|---|---|---|---|---|
| 1 | DSC weld 1 | 18 mr | 19 mr | 37 mr | baseline | |
| 2 | DSC weld 15 | 3 mr | 6 mr | 9 mr | 28 mr | |
| | | | | | | 27 DSC's X 28 mr = 756 mr reduced |
| | | | | | | 11 days X 37 mr = 407 mr reduced |
| | | | | | | Total mr saved = 1163 mr |
| MCP-91 "Alara Program and Implementation" page 13, person-rem dollar value of $6,500. | | | | | | 1.163 X $6,500 = $7560.00 |

| | |
|---|---|
| **Weld Savings:** | $1,032,750.00 |
| **Radiological Savings:** | $7560.00 |
| **Total Savings:** | $1,040,310 |

ESTIMATE BASIS FOR: Automatic Welding System

## GENERAL

The Spent Nuclear Fuel (SNF) program used a Welding Services Inc. (WSI) remote semi-automatic welding system to weld radiological shield plugs in dry shielded canisters (DSC) prior to shipping them to the interim storage facility located at the Idaho Nuclear Technology and Engineering Center (INTEC). The welding system is a gas tungsten arc welding (GTAW) process that is capable of being operated in either a manual or semi-automatic mode upon completion of a manual set-up process. It has the unique capability of having two independently operated weld heads-essentially doubling the welding rate.

## INITIAL CAPITAL INVESTMENT

Welding Services Inc. (WSI) supplied a welding system that is a gas tungsten arc welding (GTAW) process that is capable of being operated in either a manual or semi-automatic mode. It has the unique capability of having two independently operated weld heads, essentially doubling the welding rate.

The cost of the initial capital investment was $675,000 and is documented in Reference 1.

## INSTALLATION AND START-UP

Implementation costs include the actual installation and operation of the remote semi-automatic welding system and subsequent welding inspection.

The cost incurred to install, startup and operate the remote semi-automatic welding system was $1,350,000 and is based upon data from Reference 1.

ESTIMATE BASIS FOR: Automatic Welding System

**TRADITIONAL (BASELINE) TECHNOLOGY/METHOD**

The baseline welding process for the sealing of the dry shielded canisters (DSC) included manual welding operations. Both welders and inspectors participated in the process. Additionally, there were other various facility and project personnel involved in maintaining and supporting the execution of the work.

One weld was estimated at taking twelve (12) hours with eight (8) hours preparation and repair time and seven (7) hours of inspection time. Radiological exposure was estimated at a total of 37 millirem (mr) with 18 mr welder exposure and 19 mr inspector exposure.

The baseline was compared to the data accumulated on the new technology method supported by References 2 and 3.

**NEW TECHNOLOGY/METHOD**

The new technology and method included the deployment of a Welding Services Inc. (WSI) remote semi-automatic welding system to weld radiological shield plugs in DSCs prior to shipping them to the interim storage facility located at INTEC.

The new technology/method provided a faster weld deposition rate that was achieved with minimal to no rework required. Additionally, weld inspection time was reduced.

One weld was estimated at taking five and one-half (5.5) hours with little to no rework and three and one-half (3.5) hours of inspection time. Radiological exposure was reduced to a total of 9 millirem (mr) with 3 mr welder exposure and 6 mr inspector exposure.

As noted above, the accelerated welding rate and reduced inspection time resulted in lower radiological exposures. This quantifiable cost savings of $7.6K in reduced radiation exposure helped to ensure compliance with the INEEL as low as reasonably achievable (ALARA) policies.

The new technology method that was deployed resulted in projected cost savings of $1,040,000 as shown in Reference 2.

ESTIMATE BASIS FOR: Automatic Welding System

## COST SAVINGS/COST AVOIDANCE/RISK REDUCTION

The deployment of the remote semi-automatic welding system was an integral part in helping to achieve the milestone of completing the transfer of the Three Mile Island Fuel from the Test Area North to the INTEC dry storage facility before June 1, 2001. This milestone to complete the spent fuel movement is defined in the 1995 Settlement Agreement between the Department of Energy, the state of Idaho and the Navy.

By completing this significant action in a timely fashion, the INEEL, the Department of Energy and the Navy, avoided potential closure of the state of Idaho borders to future receipts of spent nuclear fuel at the INEEL. Additional associated costs and negative publicity were also avoided.

By completing the task and meeting the Settlement Agreement date, a benefit was achieved for the INEEL and the Department of Energy. On both a local and a national level, public confidence and trust in the Department of Energy and the INEEL were validated and enhanced.

Although these costs can not be specifically computed, an estimate of the benefit may be made as a cost avoidance.

The cost avoidance is estimated as $3,000,000.

# ESTIMATE BASIS FOR: Automatic Welding System

References:

1. Telephone conversation, Pete Matonis with Shane Williams, both INEEL, July 30, 2001.
2. B. Bennett, "Potential Cost Savings for TMI Cask Welding System", transmitted via electronic mail to Pete Matonis, INEEL, July 31, 2001.
3. Telephone conversations, Pete Matonis with Gaylon Hansen and Tony Wease, all INEEL, July 31, 2001.

WORKSHEET:

Itemized Project Funding Requirements: One-time usage

Figures are based upon narrative above, supported by noted References.

| | |
|---|---|
| Capital Investment: | ($ 675,000) |
| Installation Operating Expense: | ($1,350,000) |
| • Total Project Funding Requirements: | ($2,025,000) |
| • Projected Cost Savings: | $1,040,310 |
| • Estimated Cost Avoidance: | $3,000,000 |
| NET ESTIMATED SAVINGS: | $ 2,015,310 or $2000 K |

# SCIENCE AND TECHNOLOGY BENEFIT ANALYSIS
## DEPLOYMENT APPROVALS

**Technology Deployed:** Automatic Welding System

**Date Deployed:** FY-01

**EM Program(s) Impacted:** Spent Nuclear Fuel Program

Approval Signatures

Larry J. Jewell — 8/9/01

Contractor Program Manager — Date

N/A

Contractor Program Manager — Date

Peter J. Tikalsky — 8/13/01

DOE-ID Program Manager — Date

N/A

DOE-ID Program Manager — Date